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It may be shown that the condition that

$lx+my+nz=0$ ....(6) cuts $ayz+bxz+cxy=0$................(7)

in two straight lines including a right angle is $amn+bnl+clm=0$...........(8).

Comparing (5) and (6), $l=a(ax'-by'-cz')$, $m=b(-ax'+by'-cz')$, $n=c(-ax'-by'+cz')$, and (8) becomes

$$abc\{a^2x'^2-(by'-cz')^2+b^2y'^2-(cz'-ax')^2+c^2z'^2-(ax'-by')^2\}=0 \quad\text{..........}(9),$$

an identity by aid of (3).

Also solved by *HENRY HEATON* and *J. SCHEFFER*.

PROBLEMS.

65. Proposed by I. J. SCHWATT, Ph. D., Professor of Mathematics, University of Pennsylvania, Philadelphia, Pennsylvania.

Prove in a pure geometrical way the following:

The axes of the ellipse isogonal to Lemoine's line with respect to a triangle (Steiner's ellipse) are parallel to Simson's lines belonging to the extremities of Brocard's Diameter.

66. Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

The locus of points whose polars with respect to a given parabola touch the circle of curvature at the vertex is an equilateral hyperbola.

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MECHANICS.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

32. Proposed by OTTO CLAYTON, A. B., Fowler, Indiana.

The wheel of a wind pump has 60 fans, each turned at an angle of 45° to the direction of the axis, and each having 150 square inches exposed to the wind. If the wind blows with a velocity of V and the wheel rotates with velocity ω, what is the component of force or pressure along the axis if it is turned at an angte α to the direction of the wind assuming the resistance of the wheel in turning to be R?

Solution by G. B. M. ZERR, A. M., Ph. D., Texarkana, Arkansas-Texas.

Let A=projecting area of fans exposed to the wind, in square feet,
V=velocity of wind in feet per second,
H=horse hower of pump,
R=extreme radius of fans in feet,

r=inner radius of fans in feet,

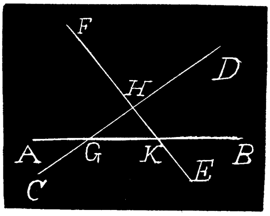
$l=\sqrt{\dfrac{R^2+r^2}{2}}$, =radius of center of percussion, in feet,

n=number of revolutions of fans per minute,

β=mean angle of fans to the plane of motion.

By Nystrom's Mechanics we get $H=\dfrac{Aln\sin\beta\cos\beta}{1.540000}\left(V-\dfrac{2ln\sin\beta}{19}\right)^2$.

Let AB, CD, FE be the direction of the axis, fans, and wind, respectively.



$\angle HKG=\alpha$, $\angle KGH=\dfrac{\pi}{4}$. $\therefore$ $\angle GKH=\left(\dfrac{3\pi}{4}-\alpha\right)$.

Then $A=60\times150\times\sin\left(\dfrac{3\pi}{4}-\alpha\right)$

$\div144=\frac{125}{2}\sin\left(\dfrac{3\pi}{4}-\alpha\right)$.

$n=\omega$, $\beta=\dfrac{\pi}{4}$. $\therefore$ $H=\dfrac{125l\omega\sin\left(\dfrac{3\pi}{4}-\alpha\right)\left(19V-l\omega\sqrt{2}\right)^2}{117040000}$

$H'=H-R/33000$=effective horse power.

35. Proposed by G. B. M. ZERR, A. M., Ph. D., Texarkana, Arkansas-Texas.

A man weighs 150 pounds; his balloon with all its attachments weighs 500 pounds. What volume of pure hydrogen must be made and put into the balloon so that it will be on the point of ascending with the man? How many kilograms of zinc and of hydrogen sulphate will be used generating the hydrogen? Give volume of hydrogen in cubic feet, given that one litre of hydrogen weighs .0896 grams.

Solution by P. S. BERG, Larimore, North Dakota, and the PROPOSER.

1 grain=.0022046 pounds. 1 cubic foot=28.315 litres.

Let temperature and pressure be normal.

$\therefore$ 1 cubic foot of hydrogen weighs $28.315\times.0896\times.0022046=.005593123$ pounds.

1 cubic foot of air weighs $28.315\times1.293\times.0022046=.080713261$ pounds.

$\therefore$ The lifting power of 1 cubic foot of hydrogen is .080713261 pounds $-$.005593123 pounds=.075120138 pounds.

500 pounds+150 pounds=650 pounds.

$650\div.075120138=8652.806$ cubic feet of hydrogen.

$8652.806\times.005593123\div2.2046=21.9524$ kilograms of hydrogen used.

$Zn+H_2SO_4=ZnSO_4+H_2$. $\therefore$ $H_2SO_4 : H_2=x : 21.9524$.

$98 : 2=x : 21.9524$. $\therefore$ $x=1075.6676$ kilograms of hydrogen sulphate.

$Zn : H_2=x : 21.9524$. $65 : 2=x : 21.9524$. $\therefore$ $x=713.453$ kilograms of zinc.

Also solved by *A. P. REED*.